



国家电网公司
STATE GRID
CORPORATION OF CHINA

THE PROSPECTIVES OF CHINESE ENERGY AND LOW CARBON ECONOMY POLICIES

Dr. Zhaoguang Hu

State Grid Energy Research Institute, China

LBNL,USA, Oct.15,2009

Contents

1. Outlook of Economy-Energy-Electricity-Environment (EEEE)
2. Energy Usage Management(EUS)
3. Integrated Resource Strategic Planning(IRSP)
4. A Map of Low-Carbon Economy
5. Policy Simulation Laboratory

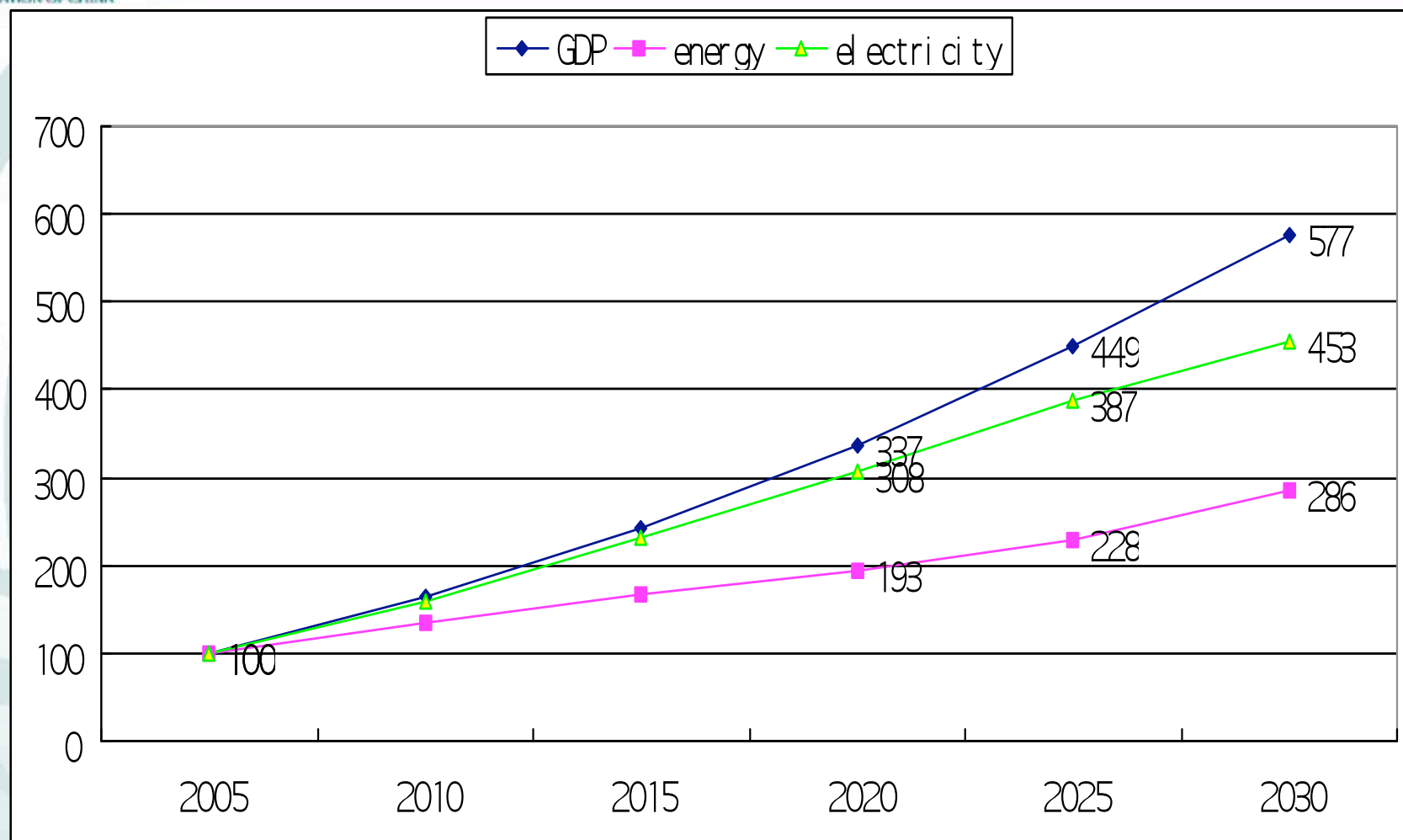


国家电网公司
STATE GRID
CORPORATION OF CHINA

1. Outlook of Economy-Energy-Electricity-Environment (EEEE)

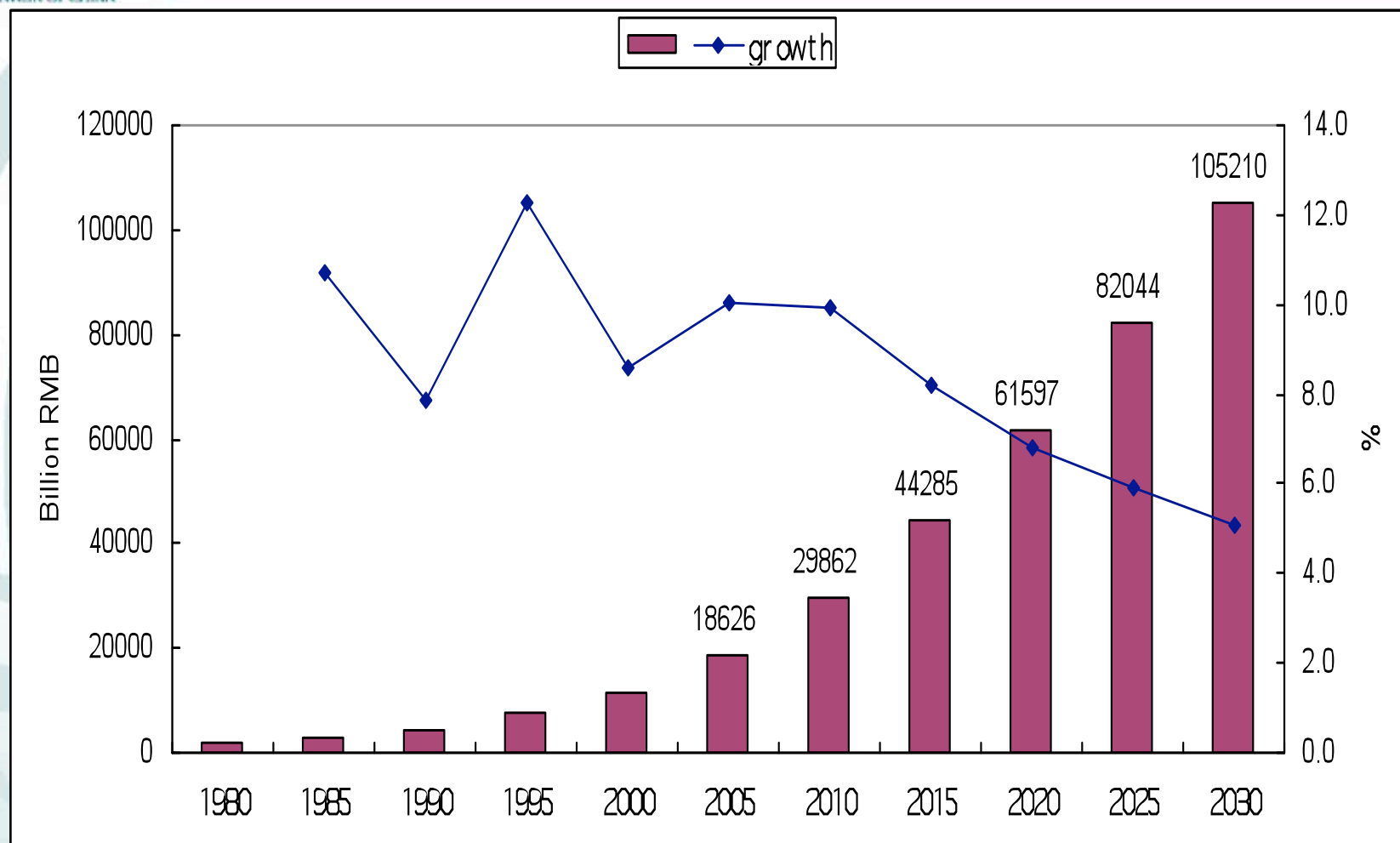
GDP-Energy-Electricity Growth

2005price



GDP and Growth

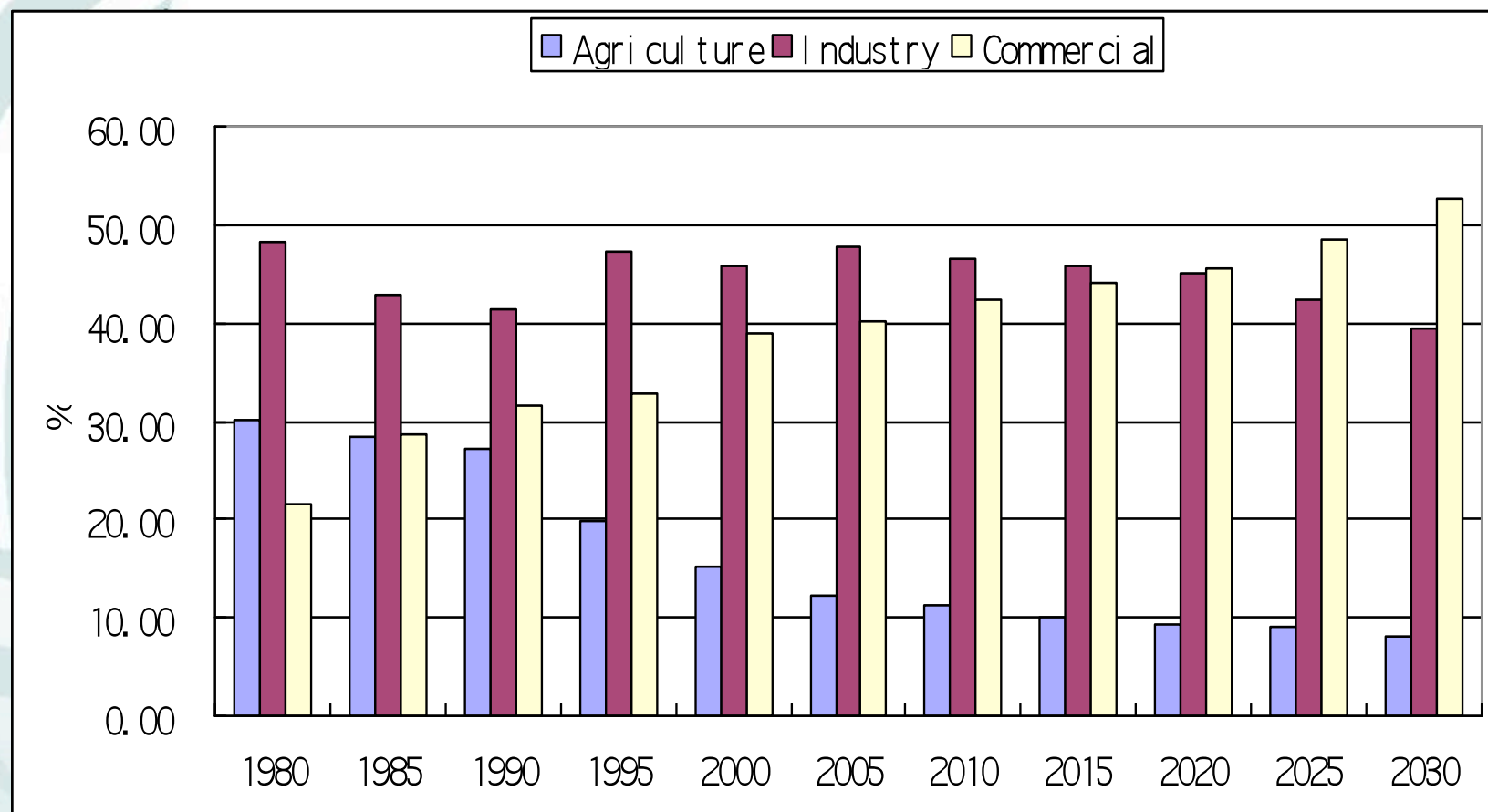
2005price



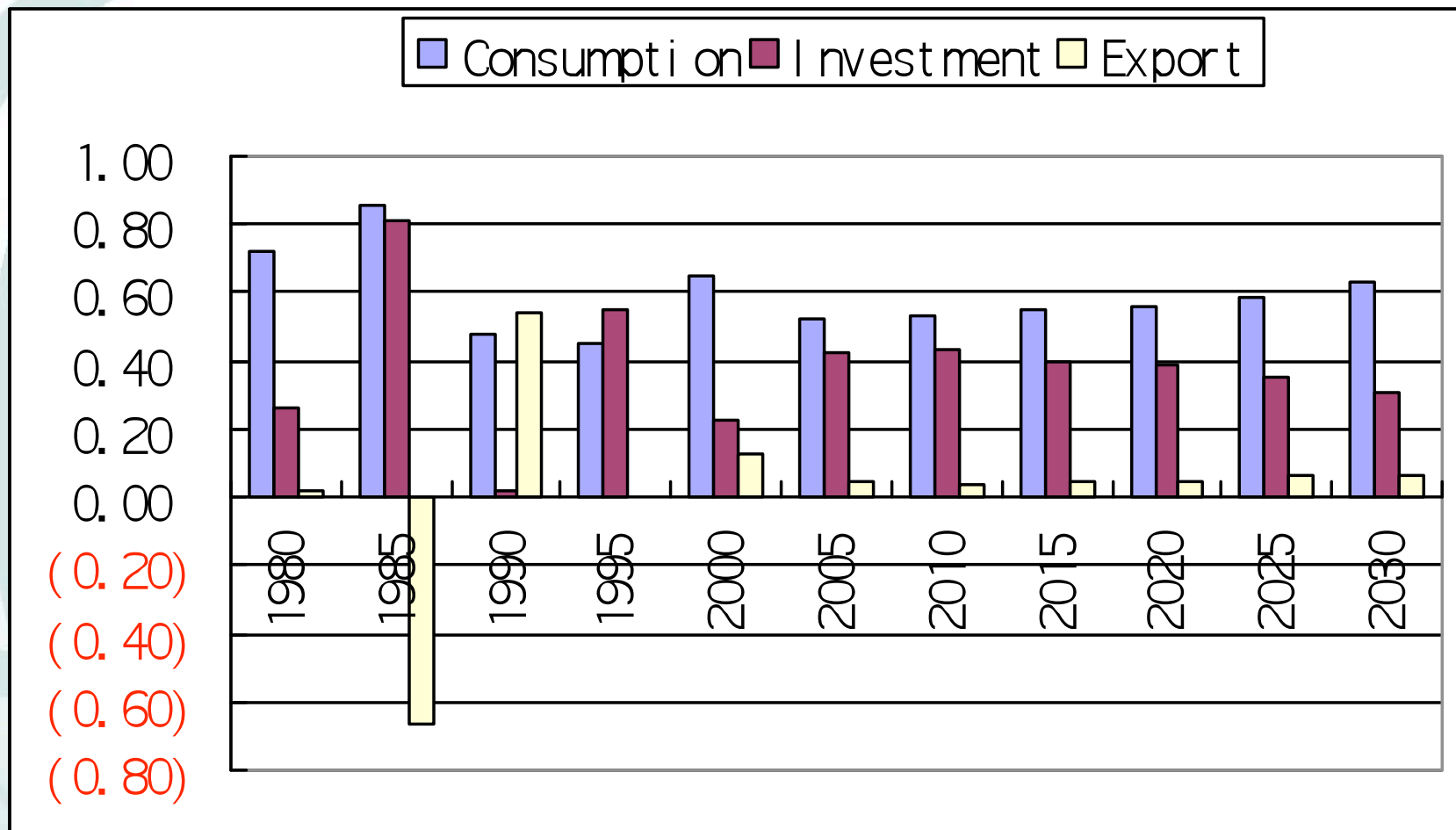


国家电网公司
STATE GRID
CORPORATION OF CHINA

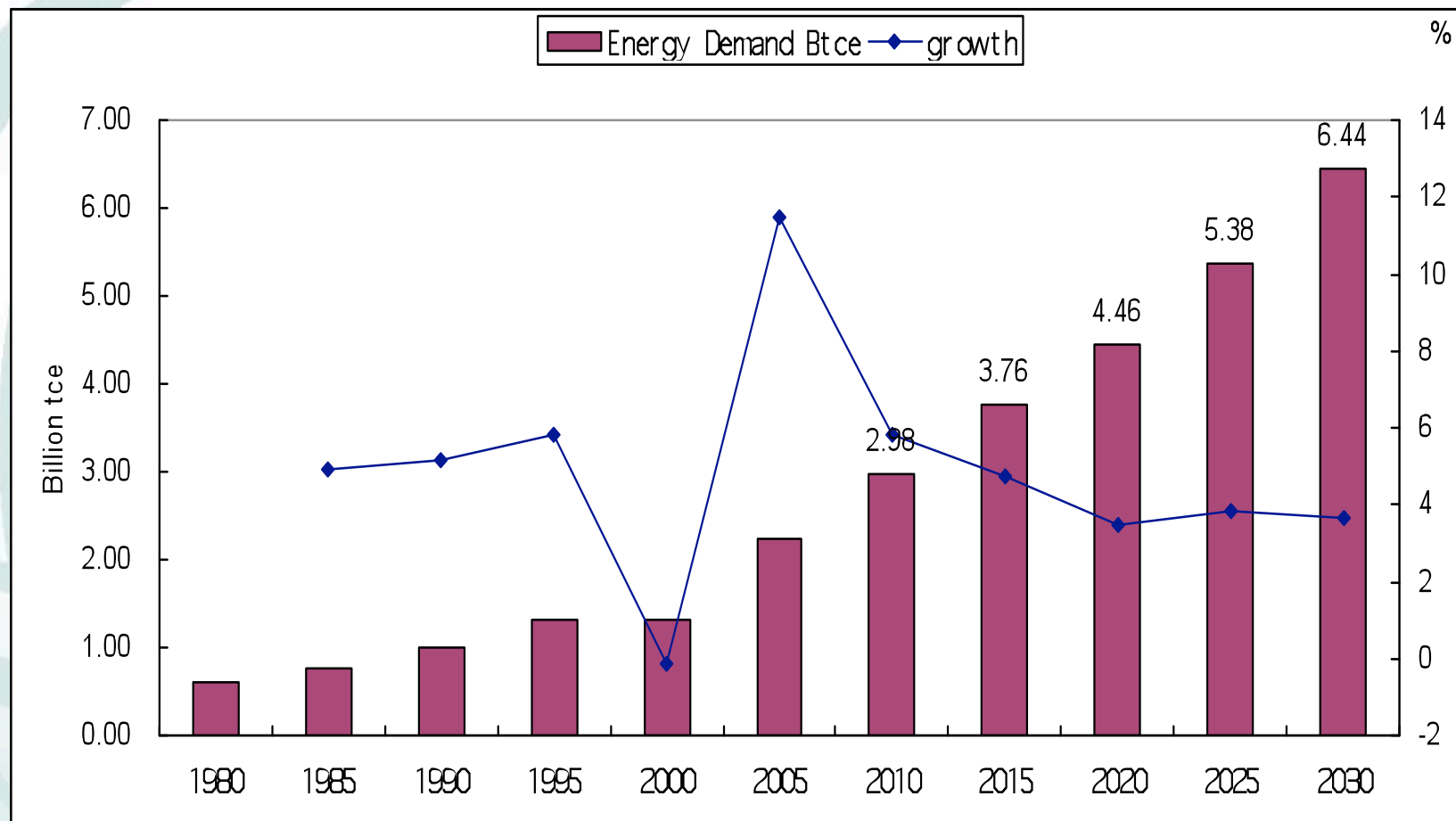
China's Economic Structure



Economic Structure



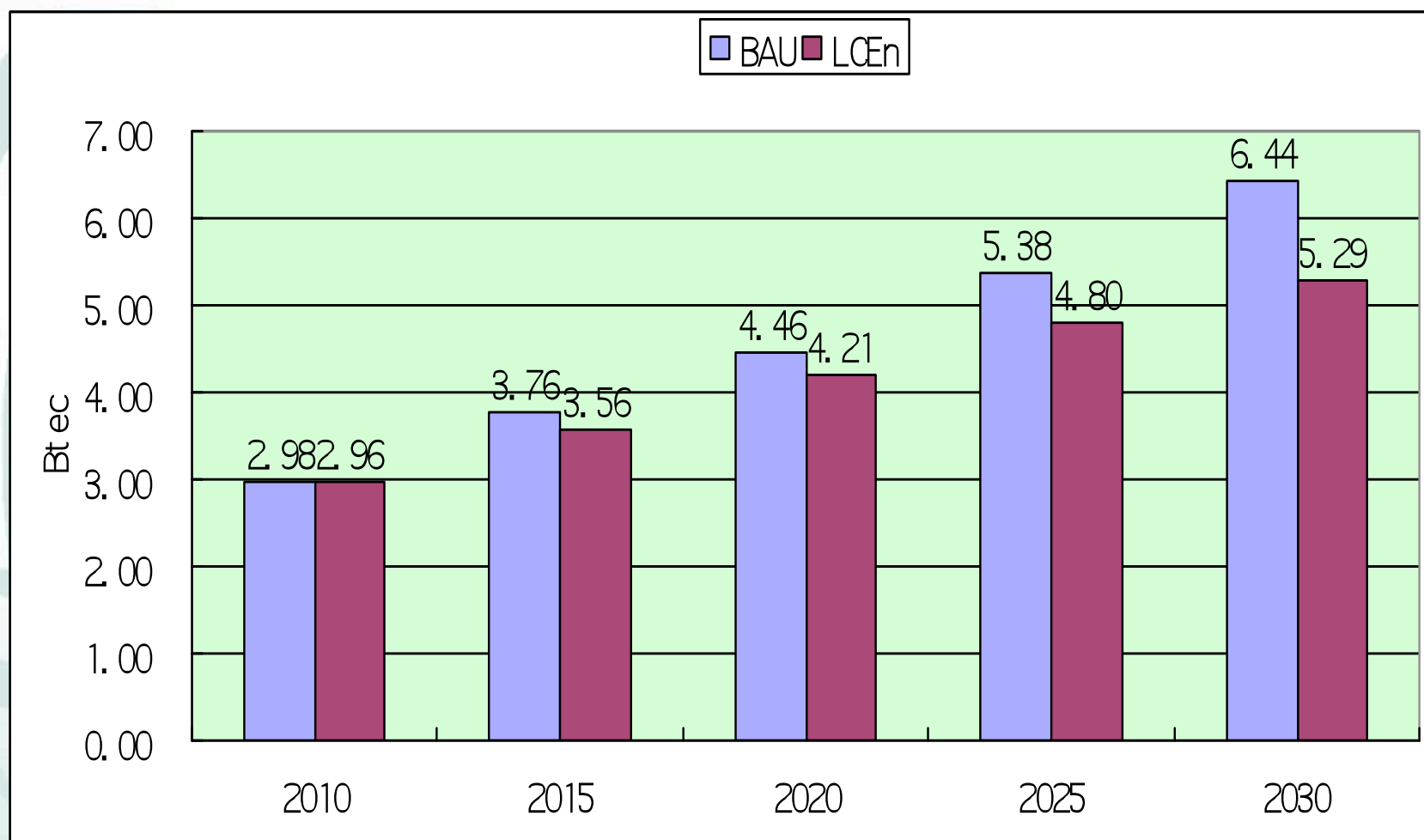
Energy Demand (Ref.)



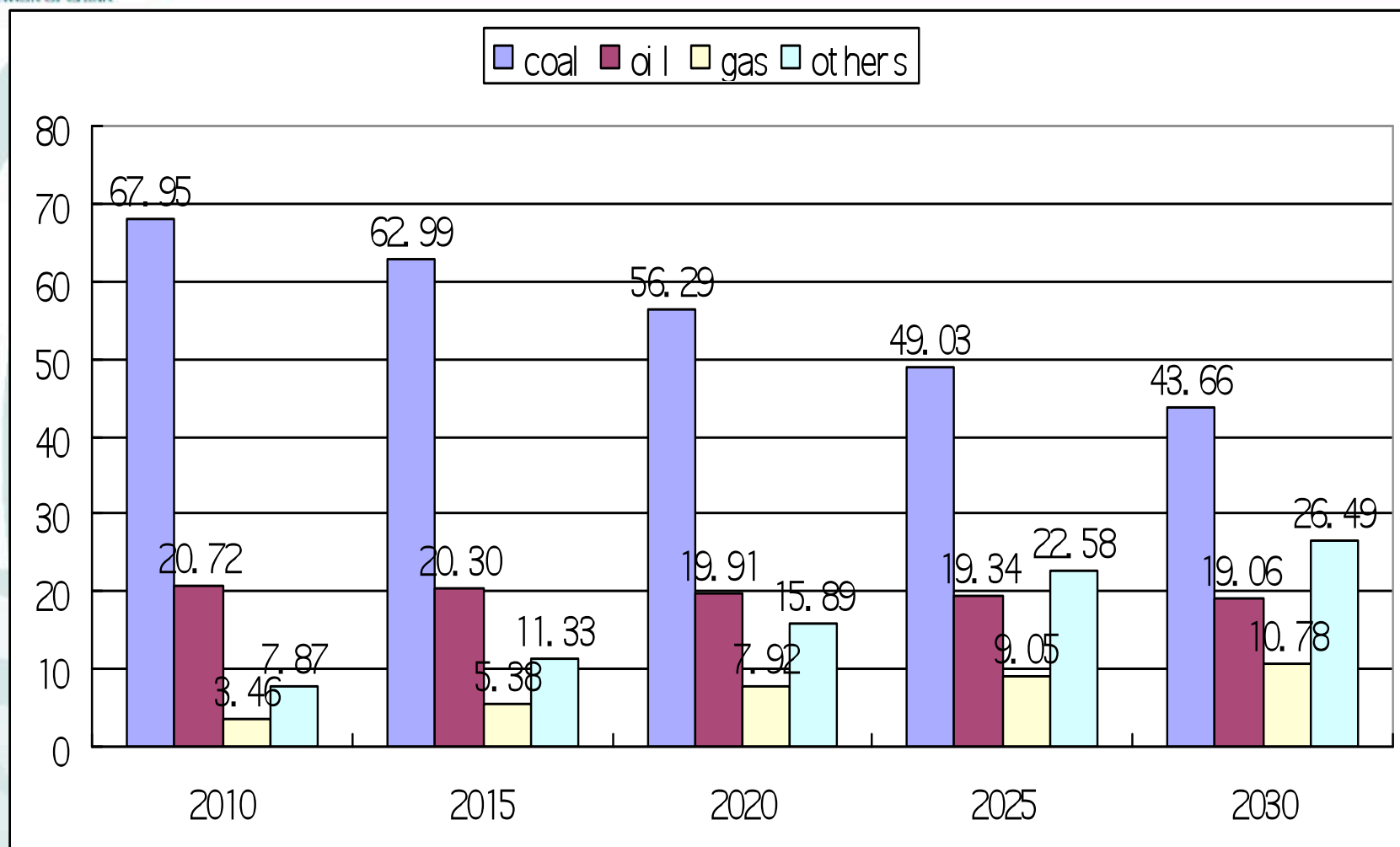


国家电网公司
STATE GRID
CORPORATION OF CHINA

5.92Btce would be saved by EUM

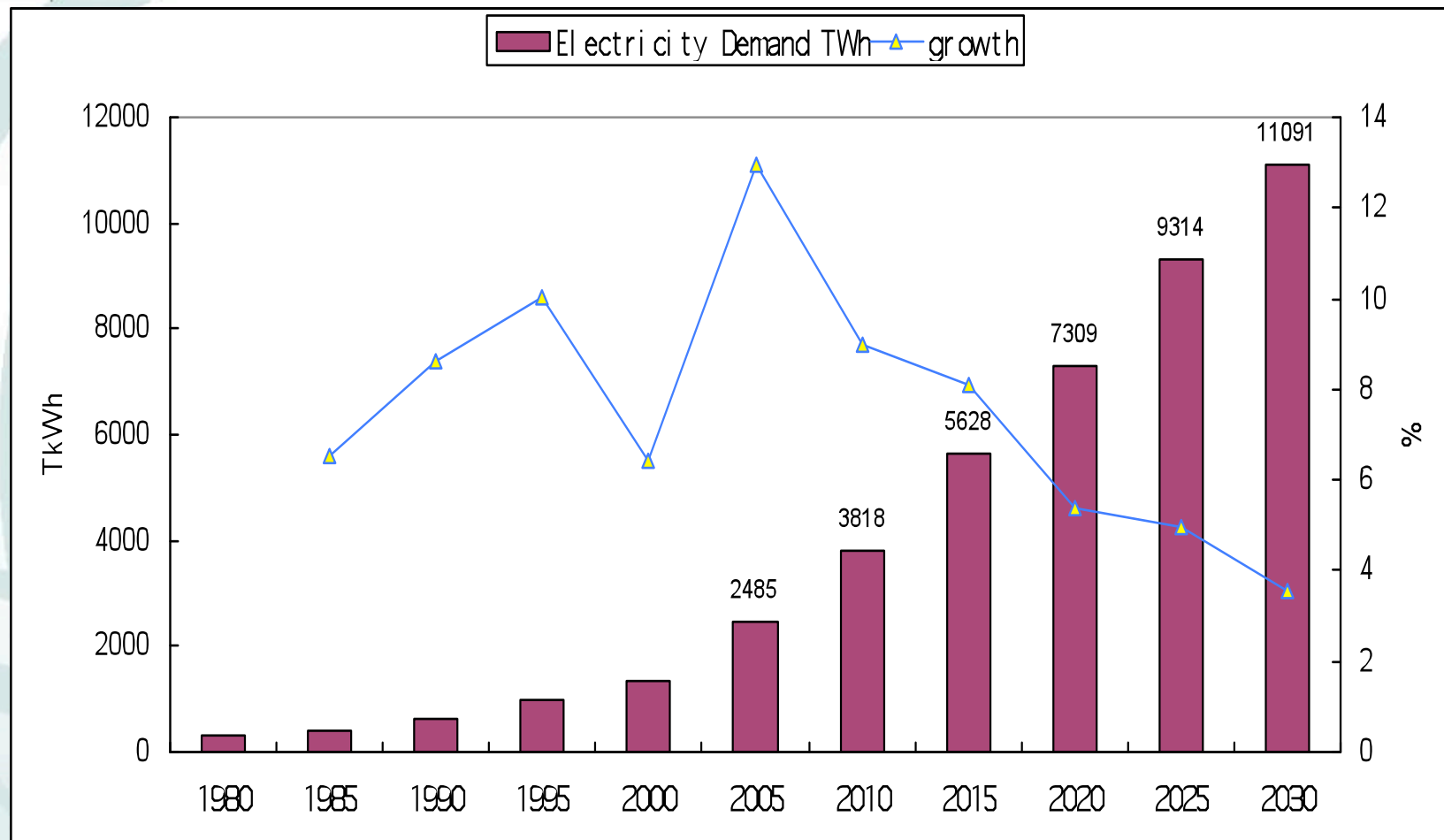


Energy Demand Structure by LCE



Electricity Demand

TWh



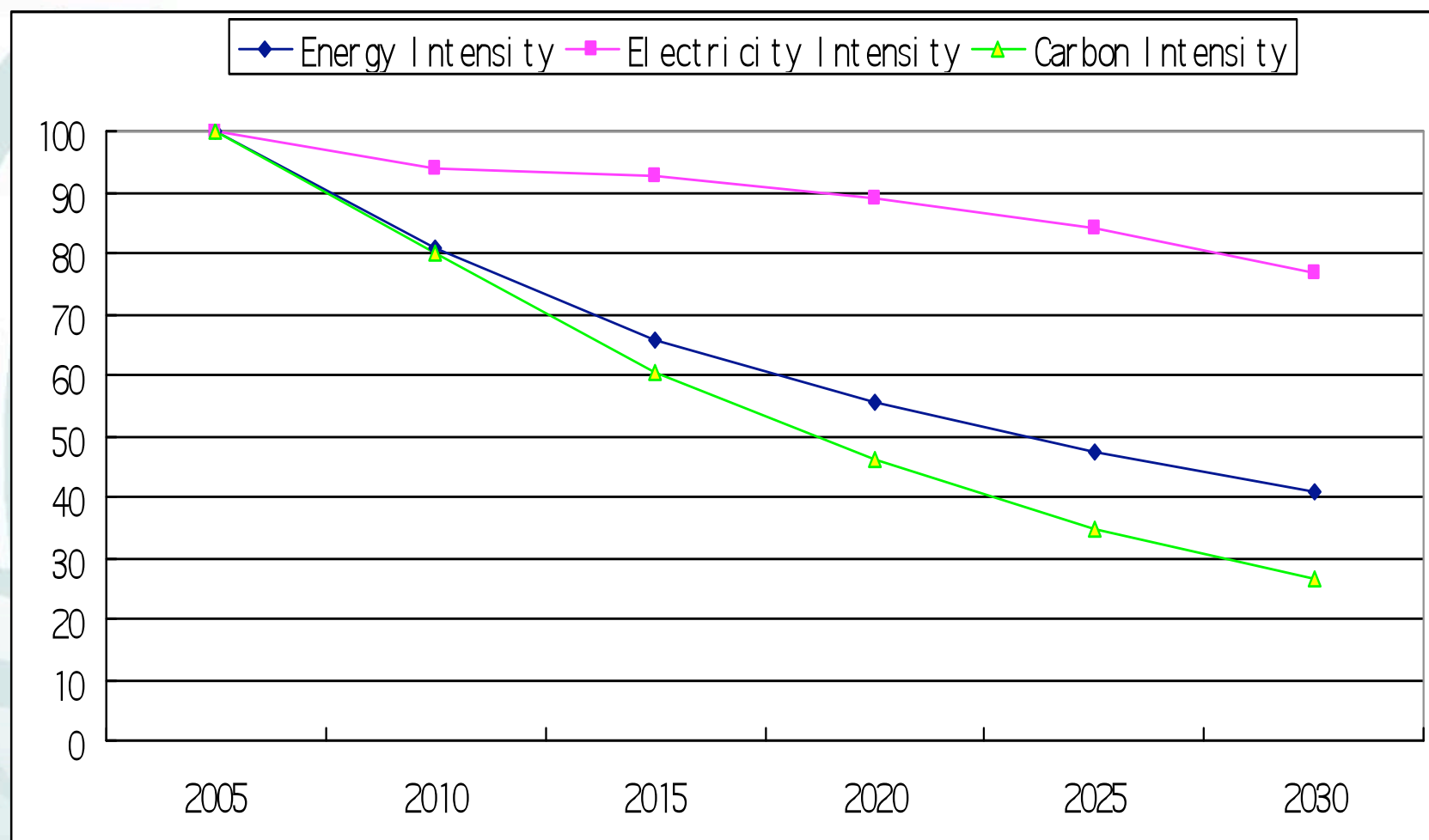


国家电网公司
STATE GRID
CORPORATION OF CHINA

Clean Electricity Generation by LCE

Electricity	2010	2015	2020	2025	2030
Clean energy generation TWH	646.2	1119.	1858.	3011.	3887.1
The share %	16.75	19.91	25.38	32.94	37.19
clean generation Capacity GW	221.2	382.3	593.0	900.0	1091.2
The share %	26.56	30.57	35.50	43.05	46.78

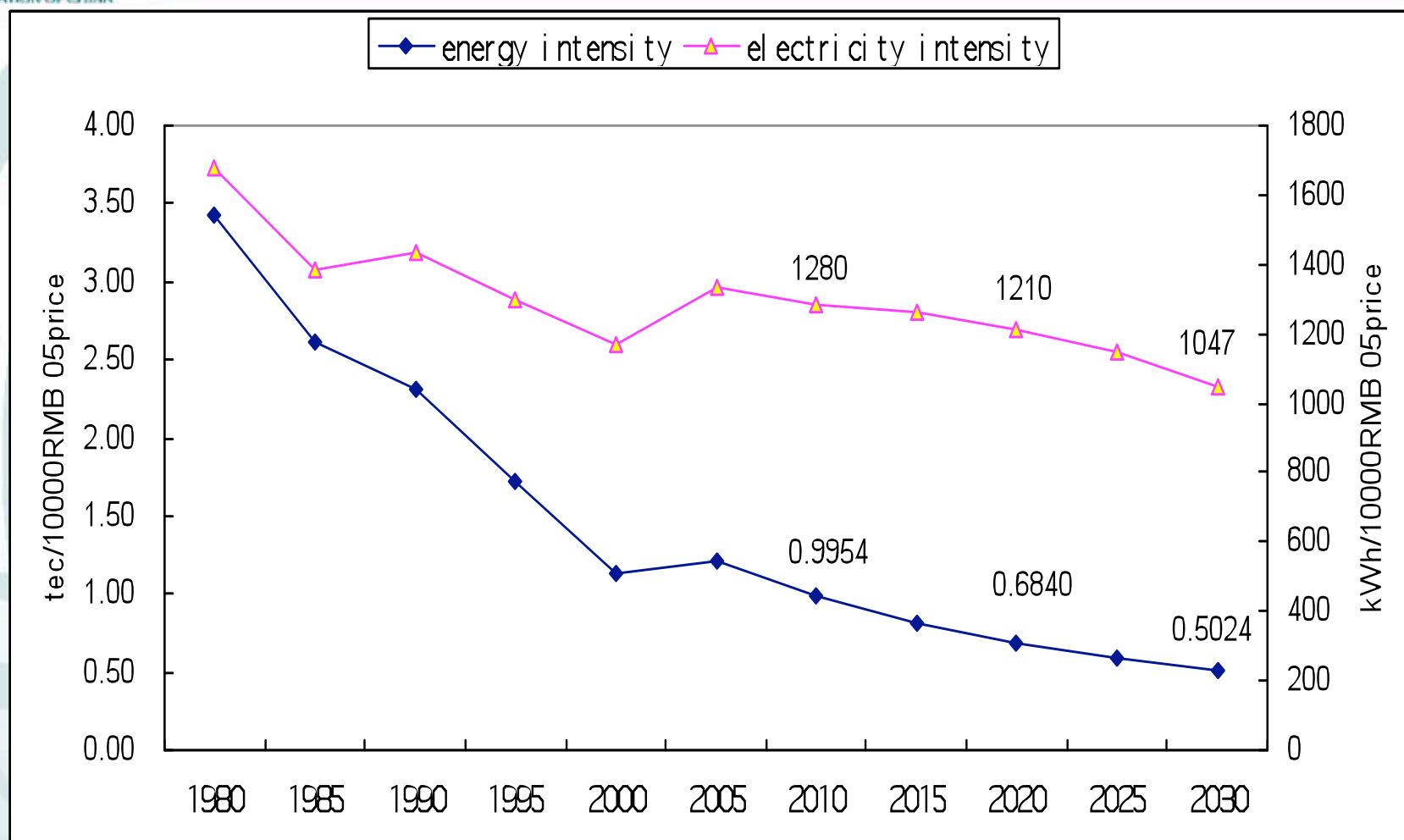
Energy-Electricity-Carbon Intensity





国家电网公司
STATE GRID
CORPORATION OF CHINA

Energy intensity and Electricity intensity (Ref.)





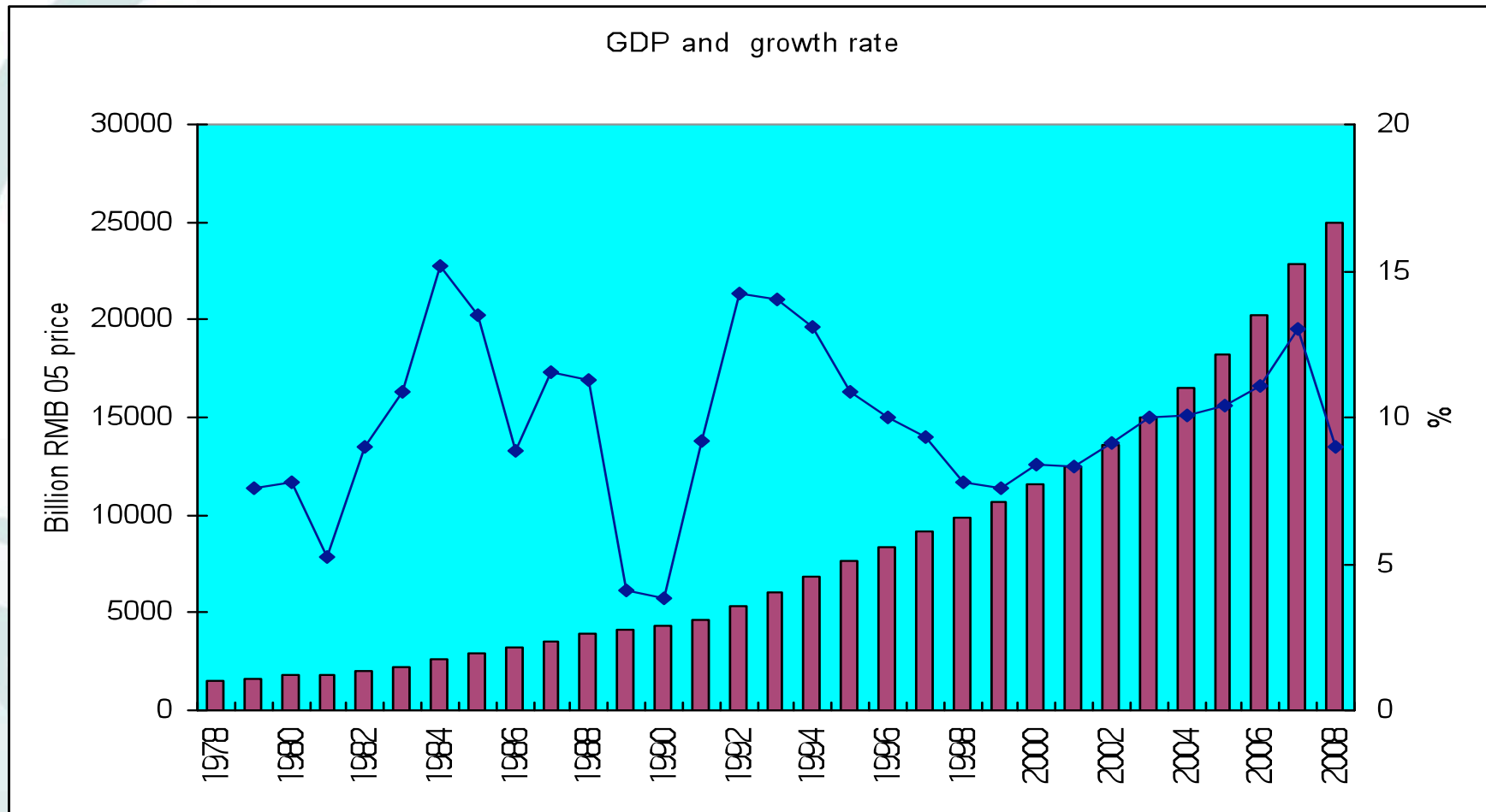
国家电网公司
STATE GRID
CORPORATION OF CHINA

2. Energy Usage Management (EUS)



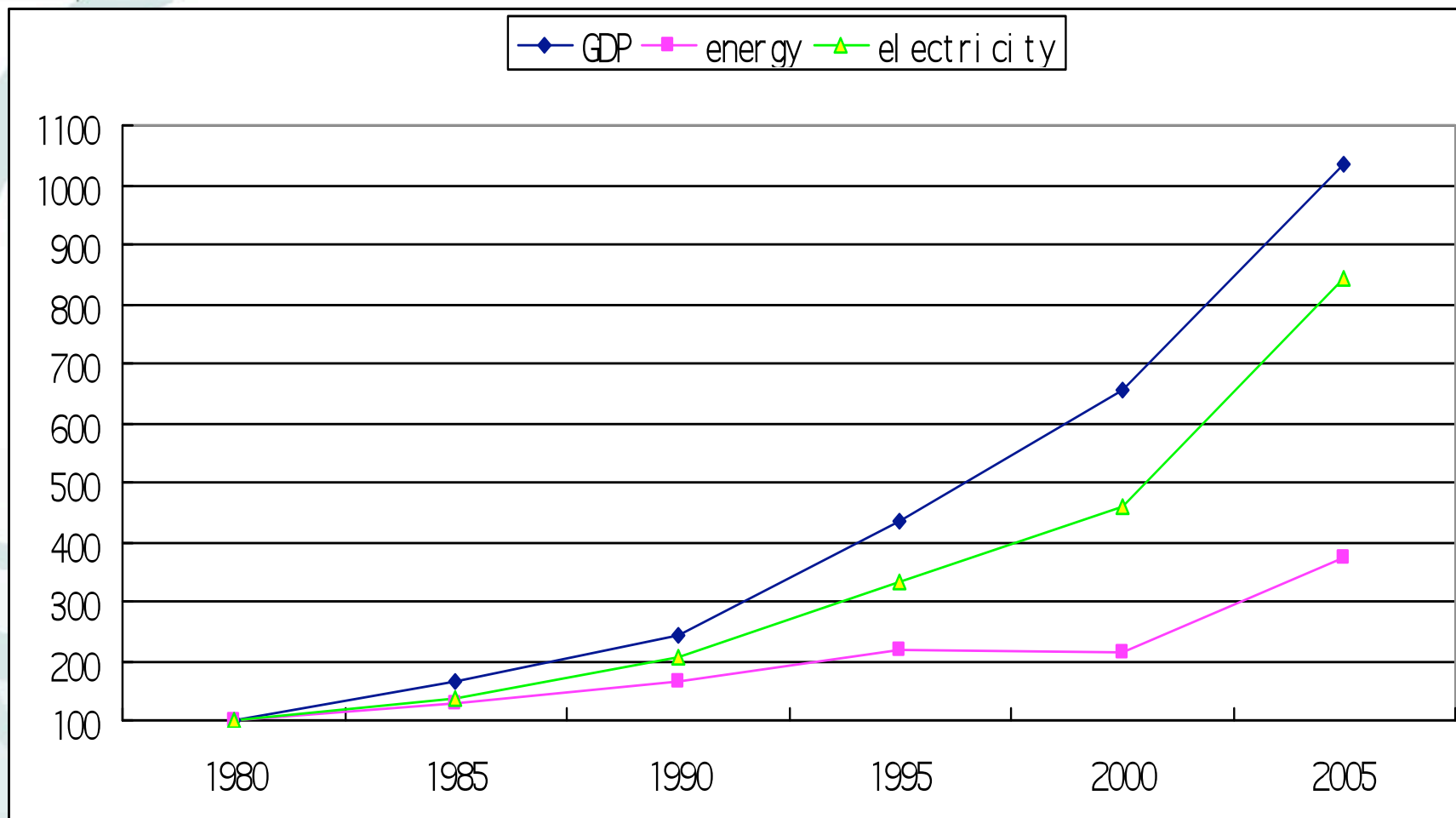
国家电网公司
STATE GRID
CORPORATION OF CHINA

China's Economic Growth

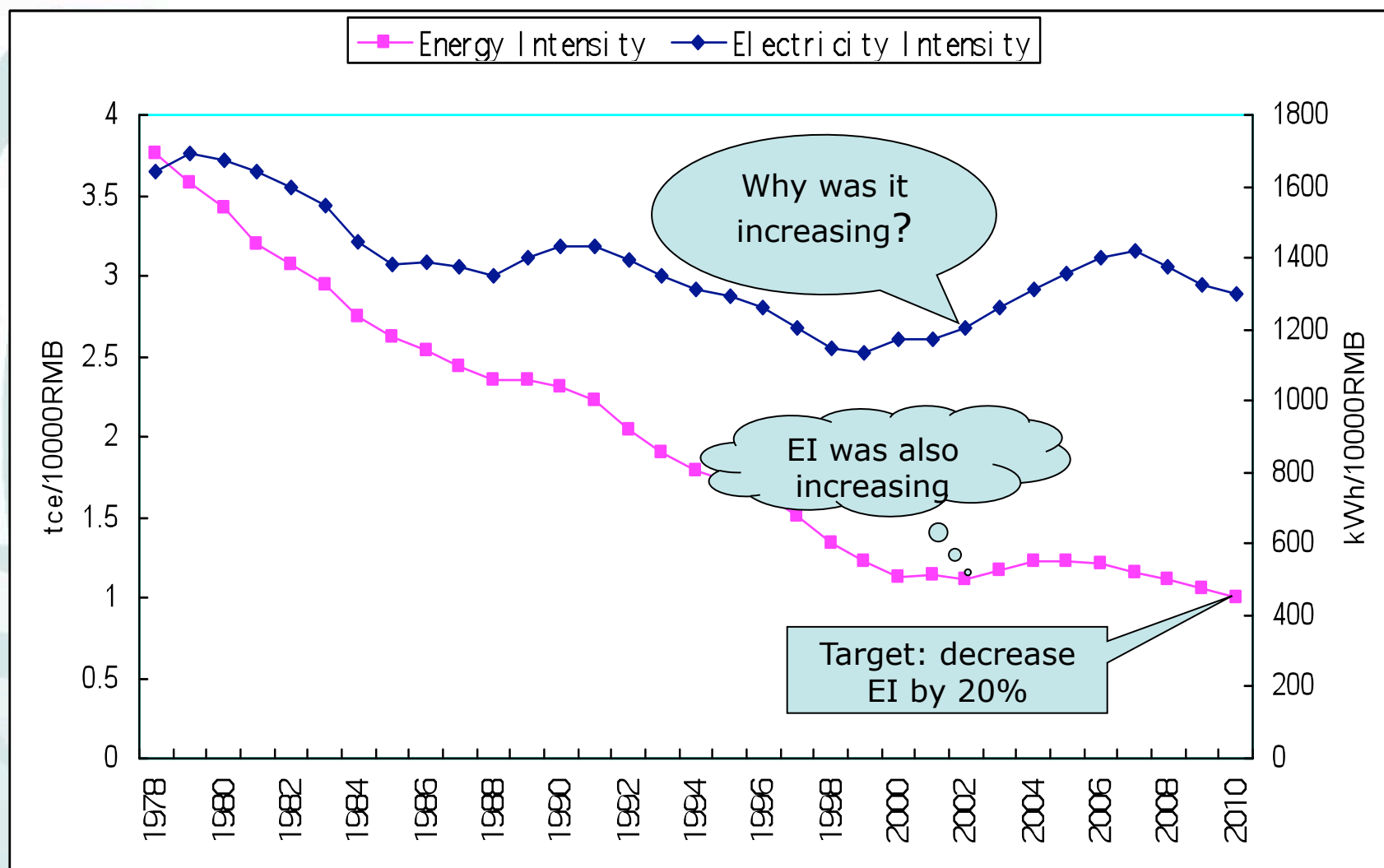


Source: National Bureau of Statistics of China

GDP Energy and Electricity Growth



Energy Intensity and Electricity Intensity



Policies and Experiences

1. Financial incentives
2. Regulations and laws
3. Cut down the low-energy efficiency product lines
4. Setting targets

Policies and Experiences

Financial incentives: around 38 Billion RMB

- Rebate 200-250 RMB/tce of coal saving
- Offer 50-90% to the cost of green-lights as subsidy
- Technical innovation fee (2 Billion RMB each year)
- Cut down the low-energy efficiency product lines (2 billion RMB)
- Vehicles and appliances rebate (7 Billion RMB)
- Local governments fund (1.5 BRMB each year)

Regulations and laws

- Energy Conservation Law (revised in 2007)
- Demand Side Management Regulations (2004-2007)
- Renewable Energy Law (2006-2009)
- The standards of products in terms of energy efficiency

Policies and Experiences

Shut down the low-energy efficiency product lines in industries.

- Coal-fired generation units <100MW, -545GW
- **Blast furnace iron making production capacity -100Million ton**
- Steel making production capacity -55Million ton
- Electrolyte aluminum -0.65Million ton
- Small Ferroalloy equipment production capacity -4Million ton
- Calcium Carbide production capacity -2Million ton
- Blast furnace Cement production capacity -2.5Billion ton
- Glass with low-efficiency production capacity -300Million box
- Paper making production capacity -6.5Million ton

Set many energy efficiency targets for all provinces and 1000 large enterprises in China.

Policies and Experiences

- In power sector, energy used for Coal-fired power plant was from 374gce/kWh (2005) to 340gce/kWh in the first 6 months of 2009.
- The energy intensity was 1.1tce/10000RMB in 2008, which is 10.2% lower than that of 2005.
- It would be 0.99tce/10000RMB in 2010, which is 19.6% lower than that of 2005.
- The electricity intensity was 1376.17kWh/10000RMB in 2008, which is 1.3 % higher than that of 2005.
- It would be 1291.96kWh/10000RMB in 2010, which is 4.9% lower than that of 2005.
- According to my previous studies, it has been proved that **electrification could reduce the energy intensity.**



国家电网公司
STATE GRID
CORPORATION OF CHINA

Industrial Energy Conservation Approach	Industry sectors	Potential of energy conservation (Mtce)	Contribution (%)
Industrial structure adjustment of inter-industry	All industry sectors	179.65	~35.6
Energy conservation techniques improvement	high-energy-consumption sectors	>132.83	>26.3
Energy-efficiency regulation of new production lines	high-energy-consumption industry	>53.78	>10.7
Close down backward production line	high-energy-consumption industry	>57.11	>11.3
Technological reconstruction of existing productivity	high-energy-consumption industry	>21.94	>4.3
Energy conservation techniques improvement	Industries as Light industry, textile, mining, etc.	~20	~4.0
Products structure adjustment	High-energy-consumption sectors and light industry, textile, etc	~100	~20
Products structure adjustment and energy conservation techniques improvement	sectors of pharmaceuticals, electronics, automobile, etc.	60~70	12~14

Energy Usage Management (EUM)

EUM is an applicable tool for government to meet the challenges of climate.

EUM:

- The adjustment of Fuel shares
- Technology innovation to improve energy efficiency
- Cut down low-efficiency production lines
- End heat re-use, wasted heat re-use
- Electric transportation



国家电网公司
STATE GRID
CORPORATION OF CHINA

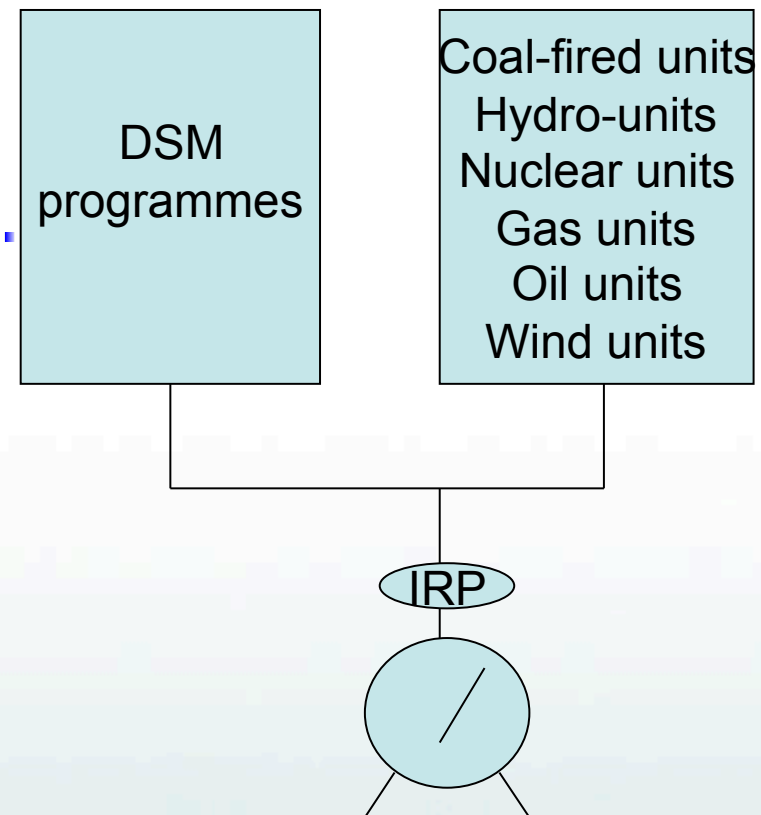
3. Integrated Resource Strategic Planning(IRSP)



国家电网公司
STATE GRID
CORPORATION OF CHINA

IRP/DSM

- IRP was the fundamental of DSM
- DSM was a part of IRP
- IPR was the planning of power utility in monopolization on power generation, transmission, distribution and sale.

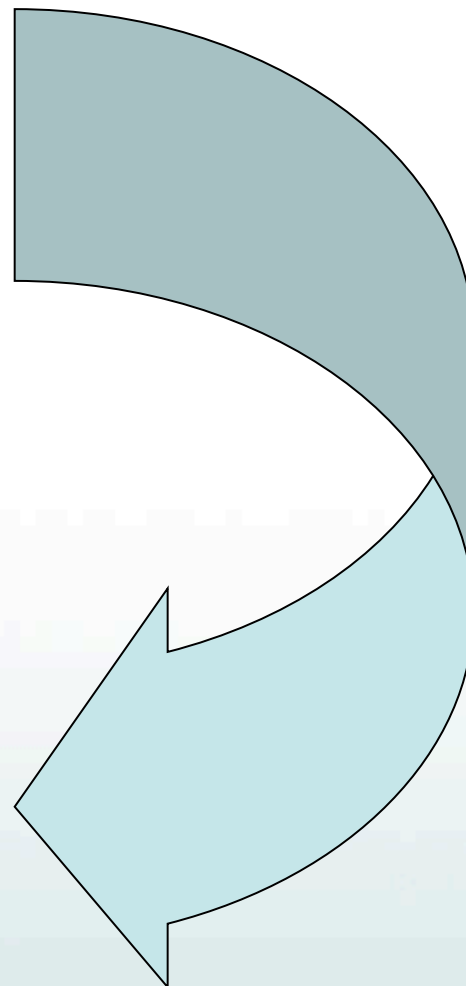




国家电网公司
STATE GRID
CORPORATION OF CHINA

- Power Market
- Energy efficiency

IRSP/DSM



Integrated Resources Strategic Planning(IRSP)

- IRSP is the national strategy planning of the multi-resources from demand side to supply side dominated by the government to meet the electricity demand in power market with the both highest of social and economic benefits in a sustainable way

IRSP and IRP

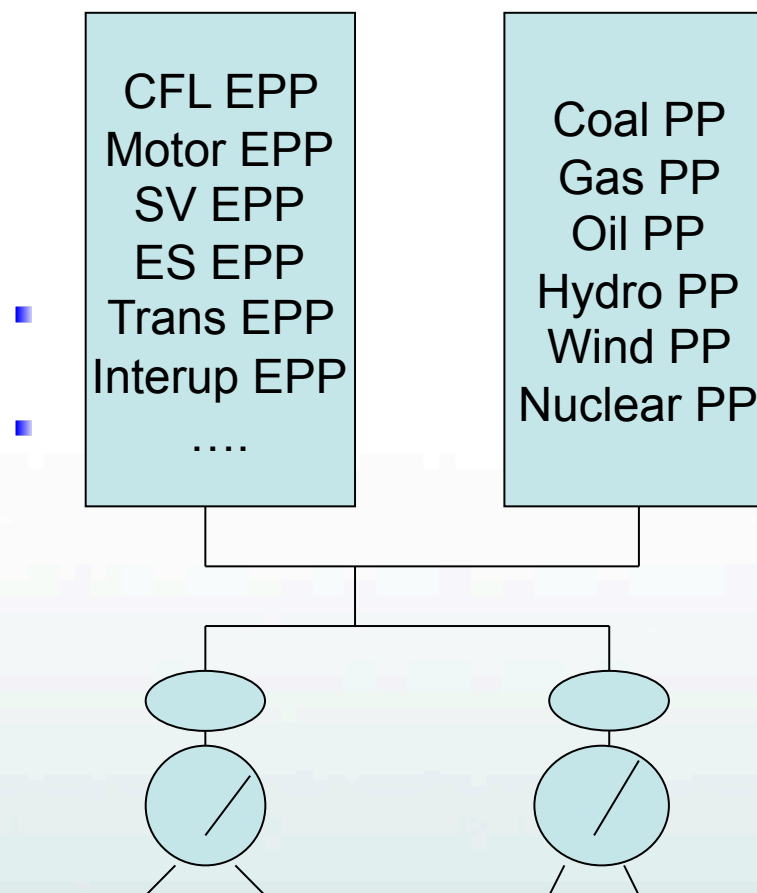
- IRSP is a national planning dominated by government
- IRP was a utility planning dominated by the power utility
- IRSP is multi-objective functions planning on maximization of social and economic benefits
- IRP was the planning on maximization of economic benefits

IRSP and IRP

- IRSP can get alternative with optimal solution in a broad area(whole country)
- IRP can get optimal solution in a limited area (utility service area)
- IRSP will be suitable for both electricity regulation and deregulation
- IRP was only suitable for electricity regulation (monopolization)

IRSP/DSM

- IRSP is the fundamental of DSM
- DSM is a part of IRSP
- IRSP is the government strategic planning with deregulation of power sector



The Benefits of Demand Side Management

- **DSM is the largest energy resource**
- **DSM is the cheapest energy resource**
- **DSM is the cleanest energy resource**
- **DSM is the fastest energy resource**
- **DSM increases energy reliability**
- **DSM increases competitiveness**
- **DSM increases energy security**
- **DSM stimulates economic development**

DSM IN CHINA 1990-2000

Energy saving	331TWh
Peak load shifting	13GW
Peak load reduction	365.GW
Coal saving	180Mtce

DSM in China in 2001-2005

- Power shortage 24-32GW
- Peak load moving 9GW (coal saving 5.6Mtce in generation side) in 2003
- Energy saving 52TWh in 2003
- Peak load moving 11GW (coal saving 6.7Mtce in generation side) in 2004
- Energy saving 81TWh in 2004
- Peak load moving 13GW (coal saving 7.2Mtce in generation side) in 2005
- Energy saving 48TWh in 2004

Power Supply in 2008

- Total generation capacity 793GW
- Coal fired power plant 601GW, 75.78%
- Hydro power 171.5GW, 21.62%
- Nuclear power 8.85GW 1.11%
- Wind 8.89GW 1.12%

Power Generation in 2008

- Total power generation 3433.4TWh, growth 5.2%
- Hydro 563.3TWh, share 16.4%
- Thermal 2779.3TWh, share 80.9%
- Nuclear 684TWh, share 1.99%。
- Wind power 12.88 share 0.37%
- Coal used in generation 350gce/kWh
- Line loss 6.8%



国家电网公司
STATE GRID
CORPORATION OF CHINA

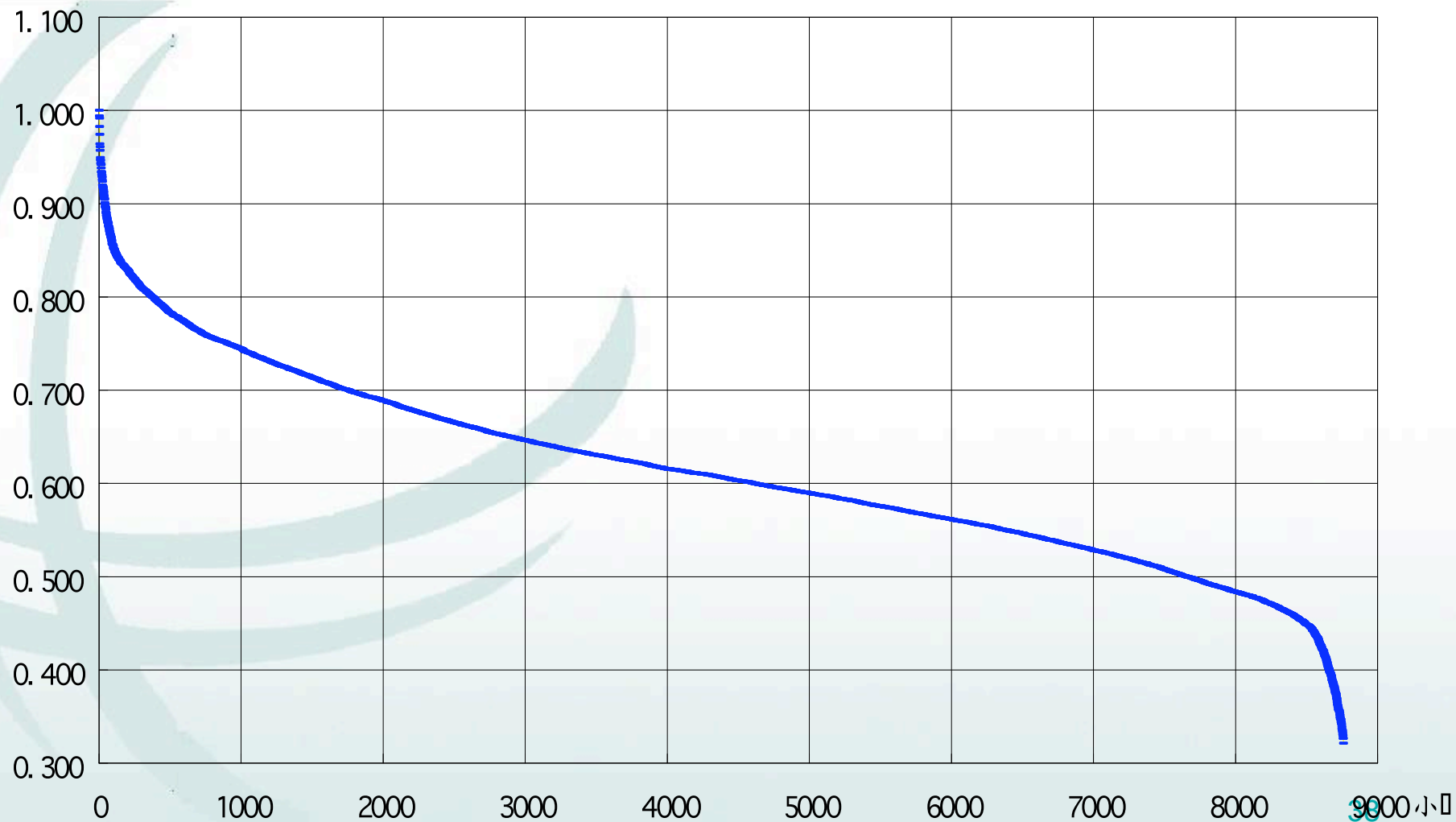
1.61Btce would be saved by IRSP

TRSP-IRSP	2010	2015	2020	2025	2030	2010-2030
Generation Capacity (GW)	832.87	1251.01	1670.32	2090.73	2332.88	
Hydro power (GW)	181.08	259.54	350.00	450.00	500.00	
Thermal Power (GW)	599.66	856.62	1033.32	1140.73	1180.40	
Nuclear Power (GW)	10.13	22.85	78.00	170.00	230.00	
Wind and Solar (GW)	30.00	100.00	165.00	280.00	361.24	
Gas Power (GW)	12.00	12.00	44.00	50.00	61.24	
Efficiency Power Plant (GW)	8.62	46.72	142.00	204.00	273.58	
Electricity Saving (TWh)	71.37	743.44	2712.37	4872.87	7732.76	63774
energy saving (Mtce)	2.43	24.52	89.47	124.55	140.23	1611.90
Mitigating Emission CO2 (Mton)	6.01	60.57	220.98	307.64	346.37	3981.39



国家电网公司
State Grid
CORPORATION OF CHINA

The top 5% peak load less than 50 hours each year



Potentials of DSM in China

- The technical potential will be around 500-900TWh and the economic potential will be around 200-300TWh annually until 2020.
- The technical potential of peak load moving will be around 50-100GW and the economic potential will be around 40-70GW annually until 2020.

By DSM

In the market mechanism, the electricity saving and peak load reduction through DSM

Then

75 GW of generation capacity would be saved in 2020

Efficiency of Load Management

- It has been proved that one percent higher of load factor will save 4gce/kwh in thermal power plants. It was 7Mtce in 2003 in North China.

Opportunities

- China's Economic progress will be higher in the next 20 years. Power demand will be high increased. The investment on DSM will be around 60 **Billion USD** each year.
- International cooperation on energy efficiency in both power supply and demand sides.

Conclusion

- There is great opportunity for energy efficiency in China
- There is great potentials for DSM in China
- Energy conservation has been put as the first priority of strategic option for sustainable development in China
- The market is great too

Conclusions

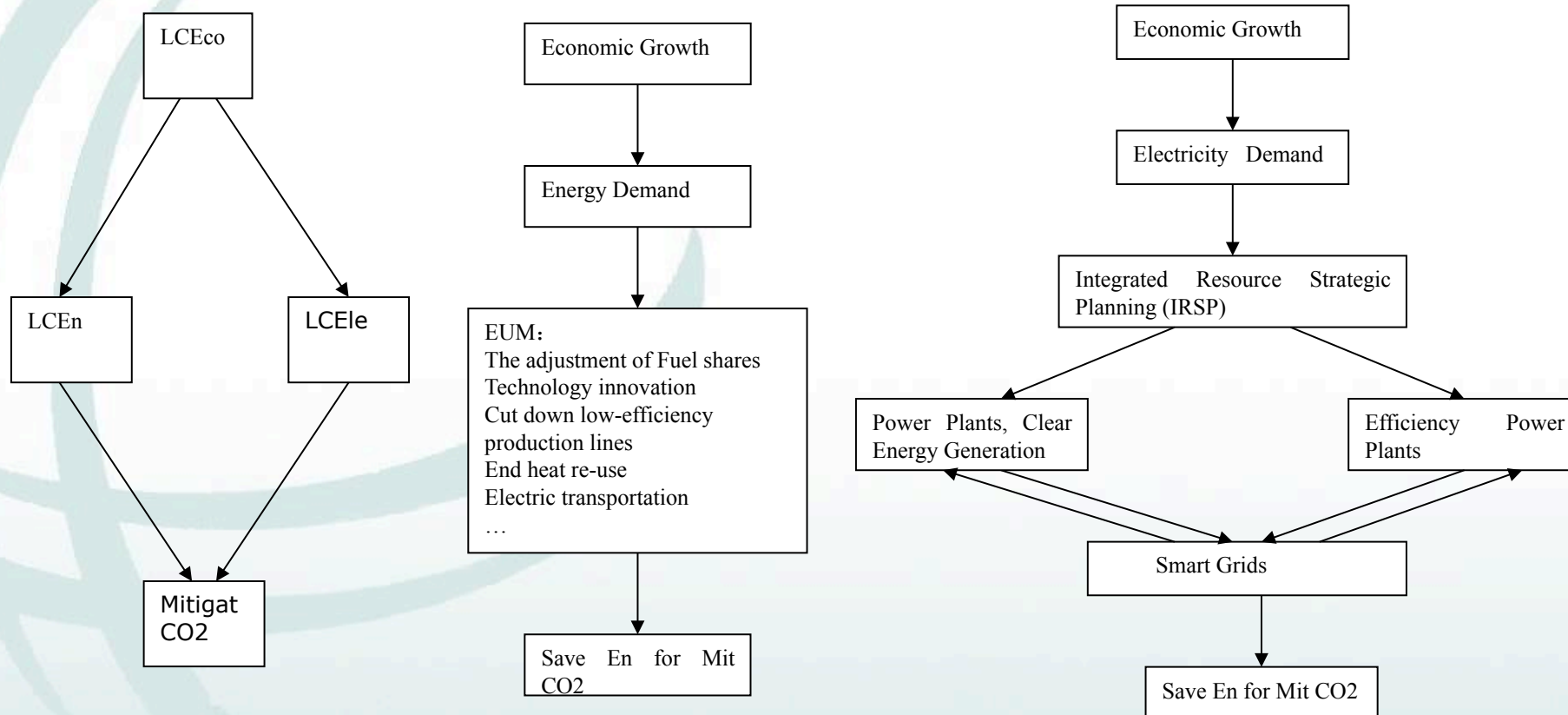
- IRSP can evaluate the cost optimum of EPP compared with the traditional resources, the savings of electricity, coal and gas will be 2.4%, 2.3% and 2.4% respectively 2008-2020 in California.
- Many EPP are not the most economic resource in some years, i.e. incentive policy on financial support is necessary to lower down the cost of these expensive EPP.
- IRSP is an useful tool for EE and policy study.



国家电网公司
STATE GRID
CORPORATION OF CHINA

4. A Map of Low-Carbon Economy

The Map of Low-Carbon Economy



The Low-Carbon Economy Model

The Low-Carbon Economy

= Low-Carbon Energy + Low-Carbon Electricity

= EUM + Integrated Resource Strategic Planning

= 5.59Btce + 1.61Btec Energy saving for the next 20 years

= 13.8Bton + 3.98 Bton CO₂ mitigating for the next 20 years

= 17.78 Bton

Conclusion

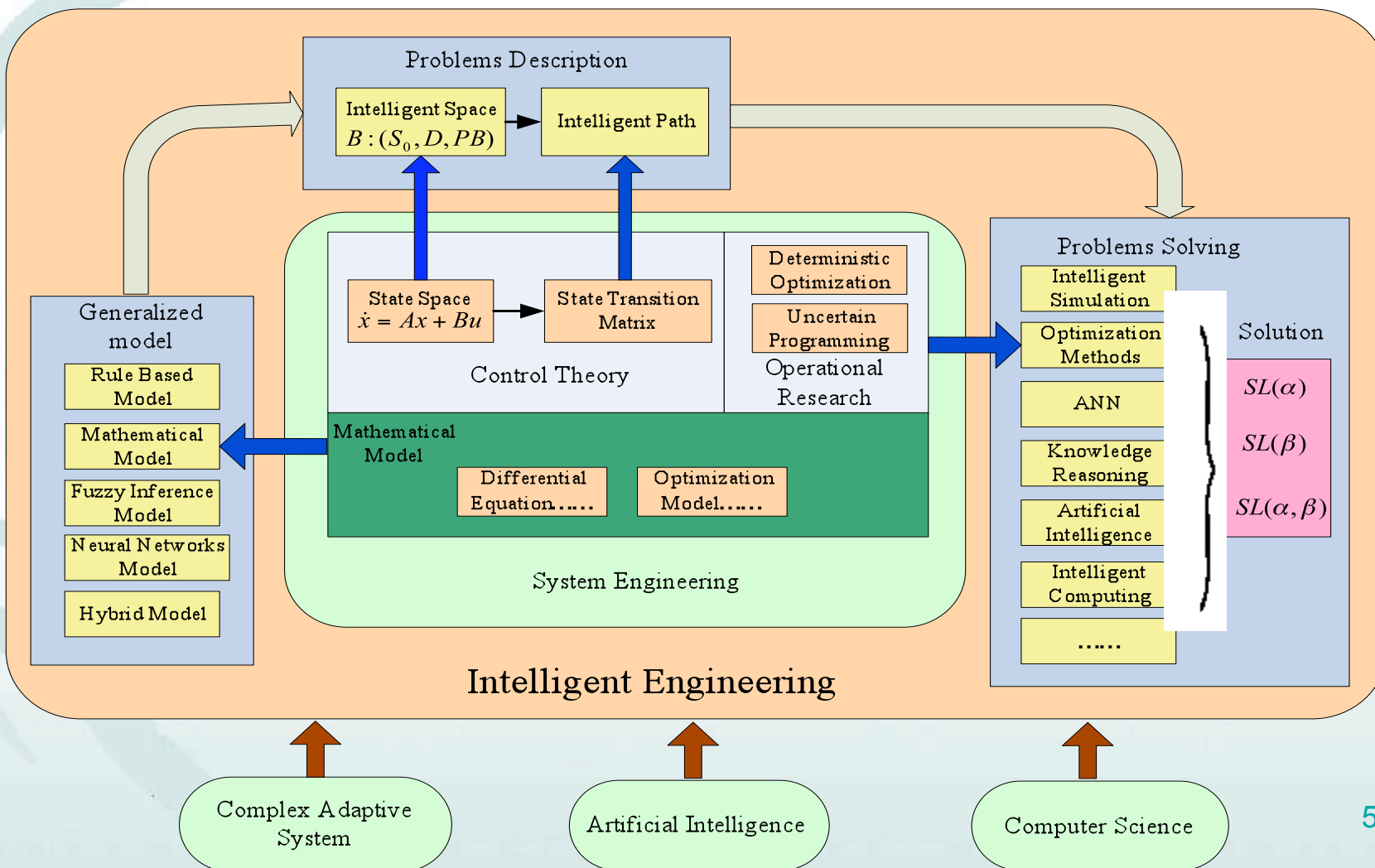
1. China's experience of Low-Carbon Economy has made its energy intensity turned down 10.2% with energy saving 0.51Btce and mitigating emission CO₂ 1.27Bton in 2005-2008. By the year of 2010, the energy intensity will decrease 20% with energy saving 1.69Btce and mitigating emission CO₂ 4.17Bton in the 5 years.
2. China's energy intensity would decrease in the next 20 years with the Low-Carbon Economy model.
3. The Energy Usage Management (EUM) and the Integrated Resource Strategic Planning (IRSP) would play an important role globally in the mitigating emissions CO₂ and climate change. It could be an useful tool on studying climate change policies for governments.



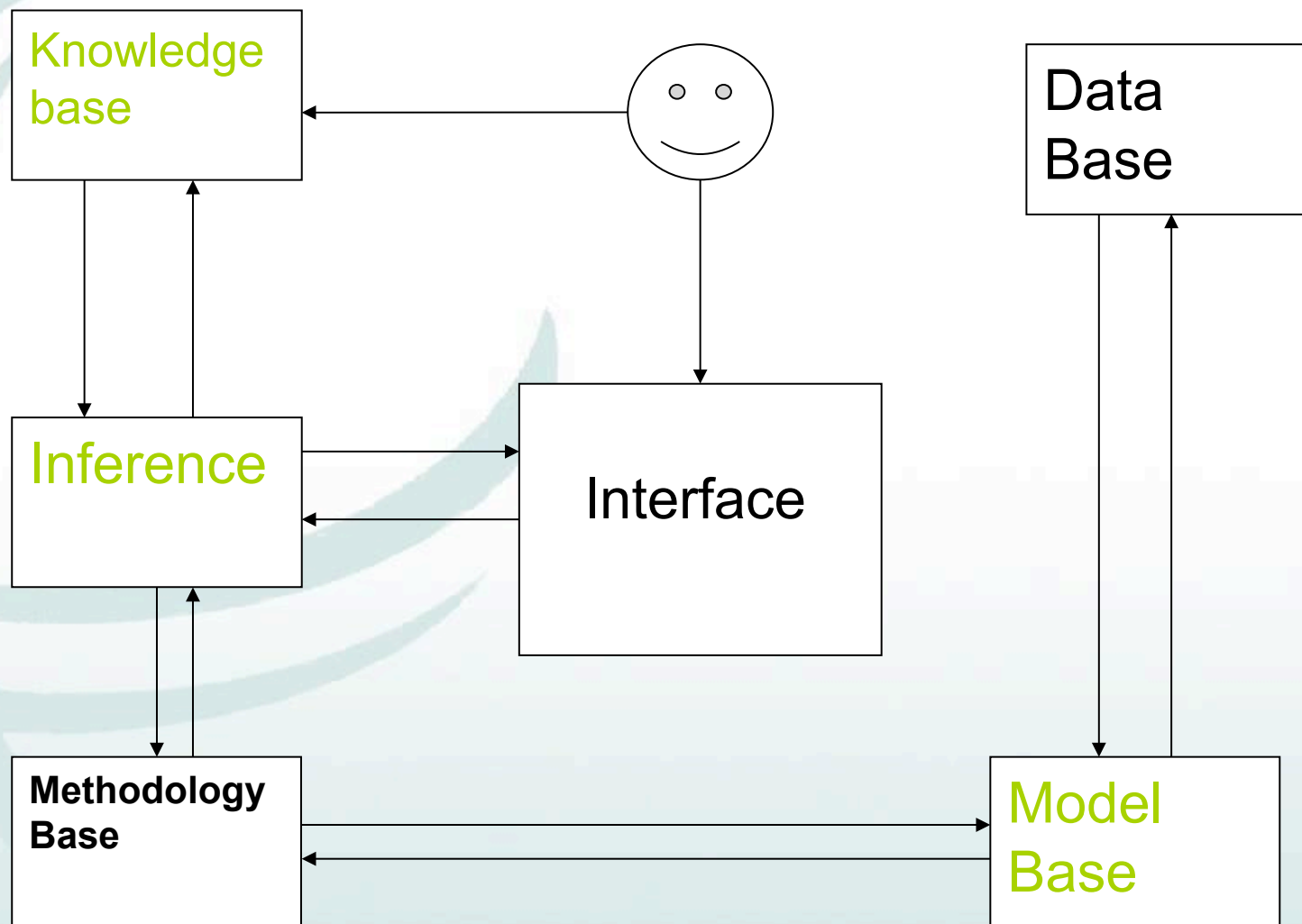
国家电网公司
STATE GRID
CORPORATION OF CHINA

5. Policy Simulation Laboratory by Intelligent Engineering

Methodology of Intelligent Engineering



Laboratory of Policy Simulation



Model Base

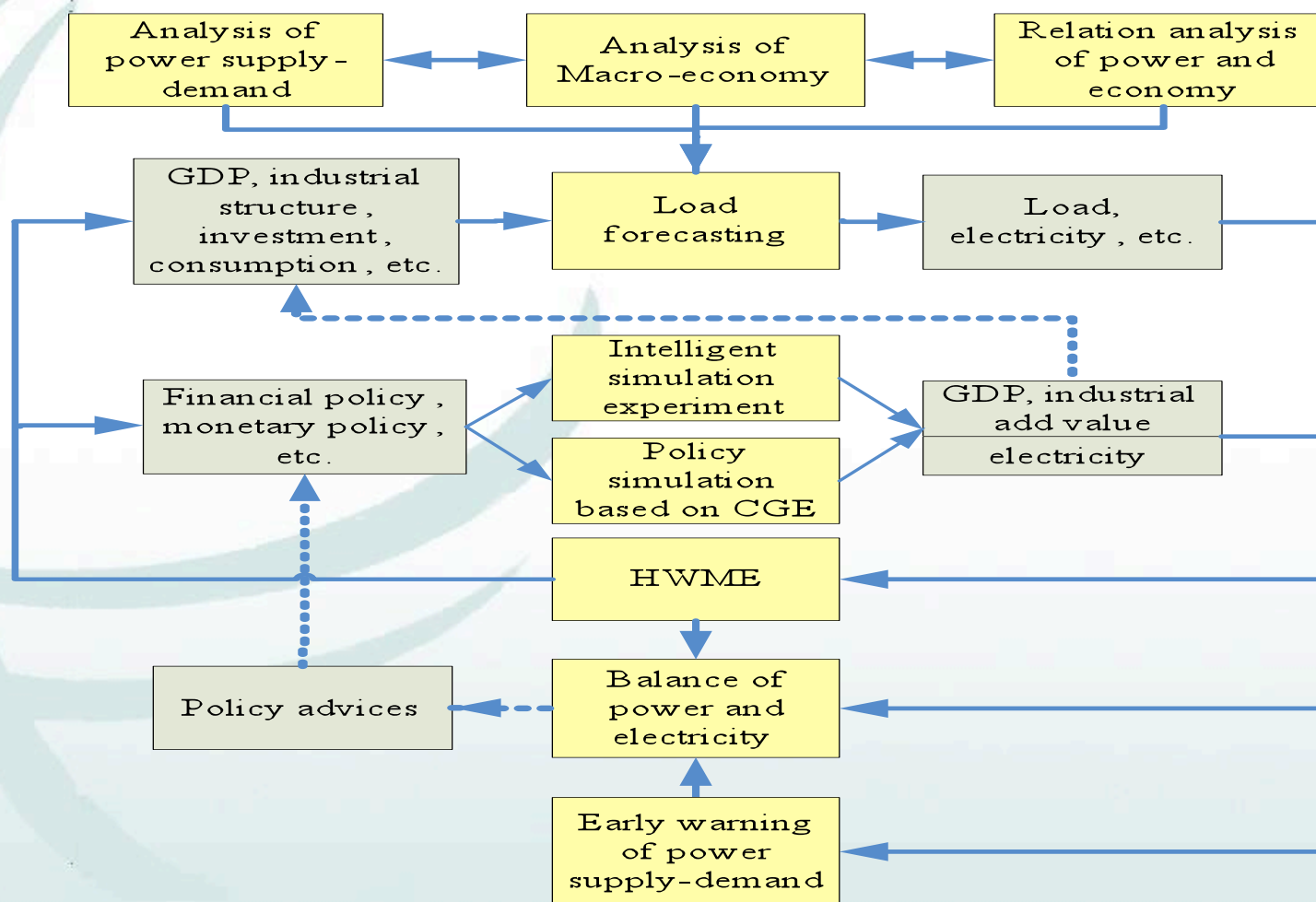
- Economic model
- Economic-Energy model
- Economic-Electricity model
- Environment model
- Grey model
- Load forecasting model
- ...

Methodology Base

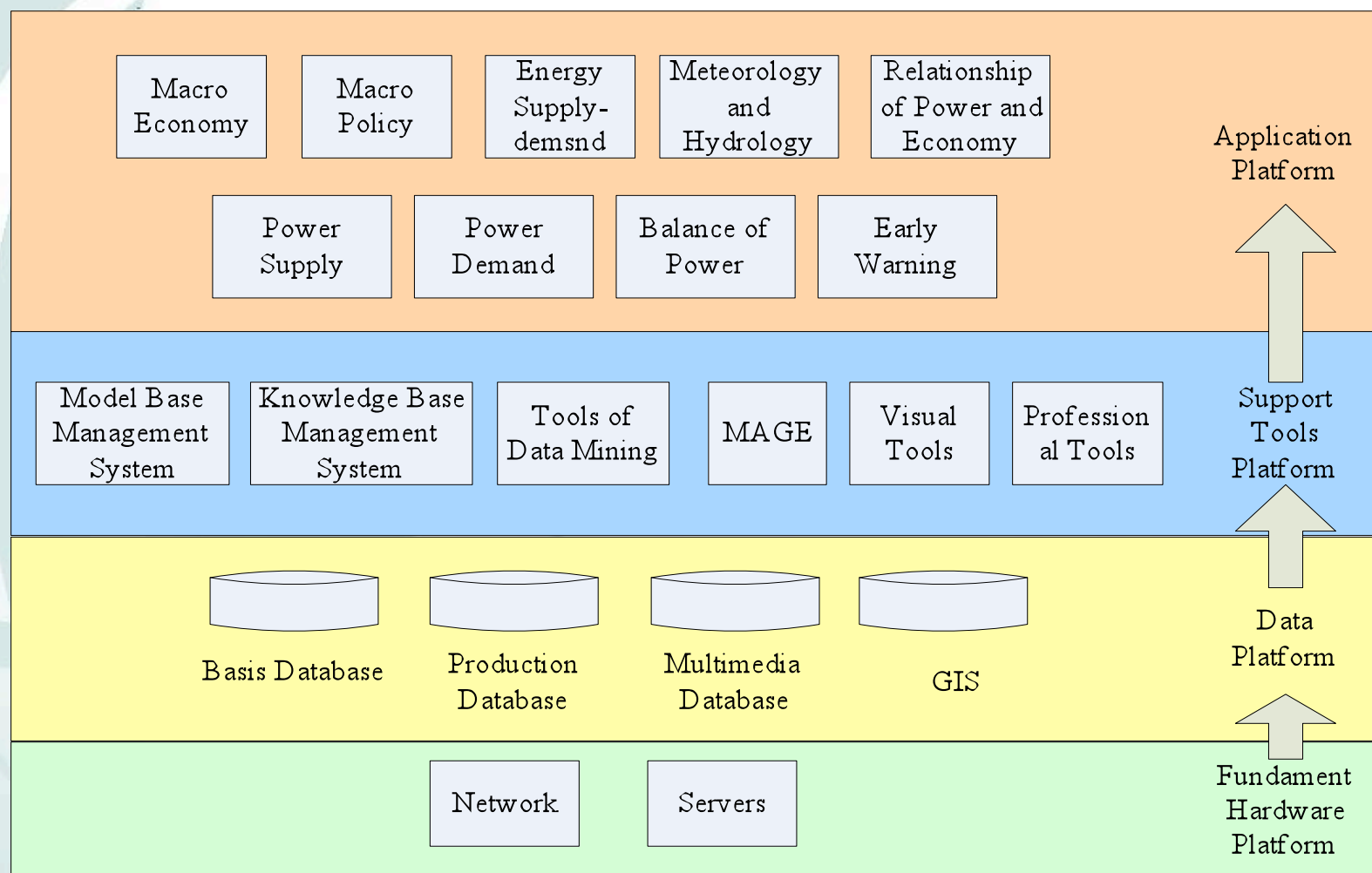
- Fuzzy inference
- Neural Networks
- Genetic algorithm
- Grey method
- Agent
- ...



Principles of the Laboratory

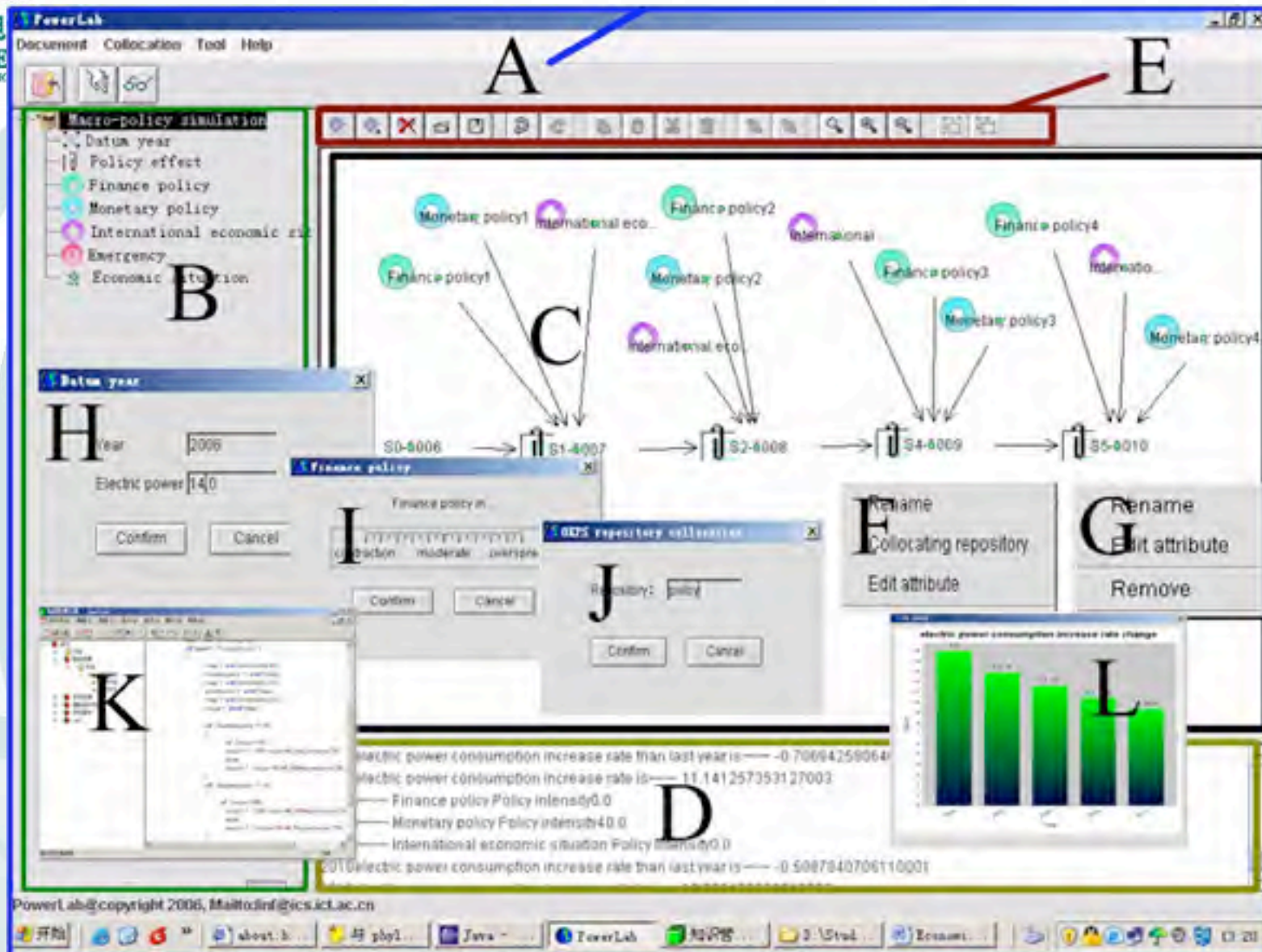


Structure of the laboratory





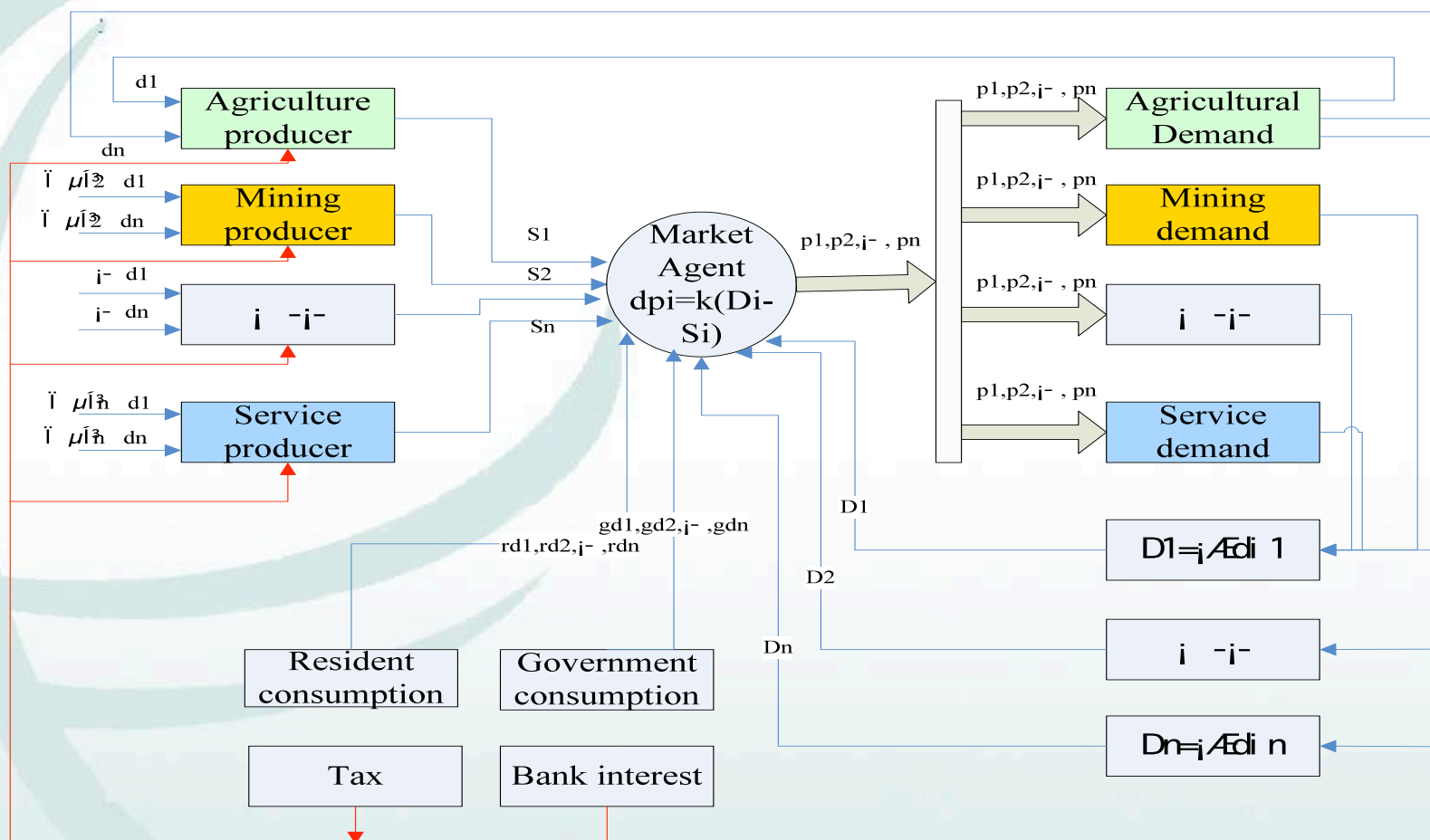
国家电网
STATE
GRID
CORPORATION



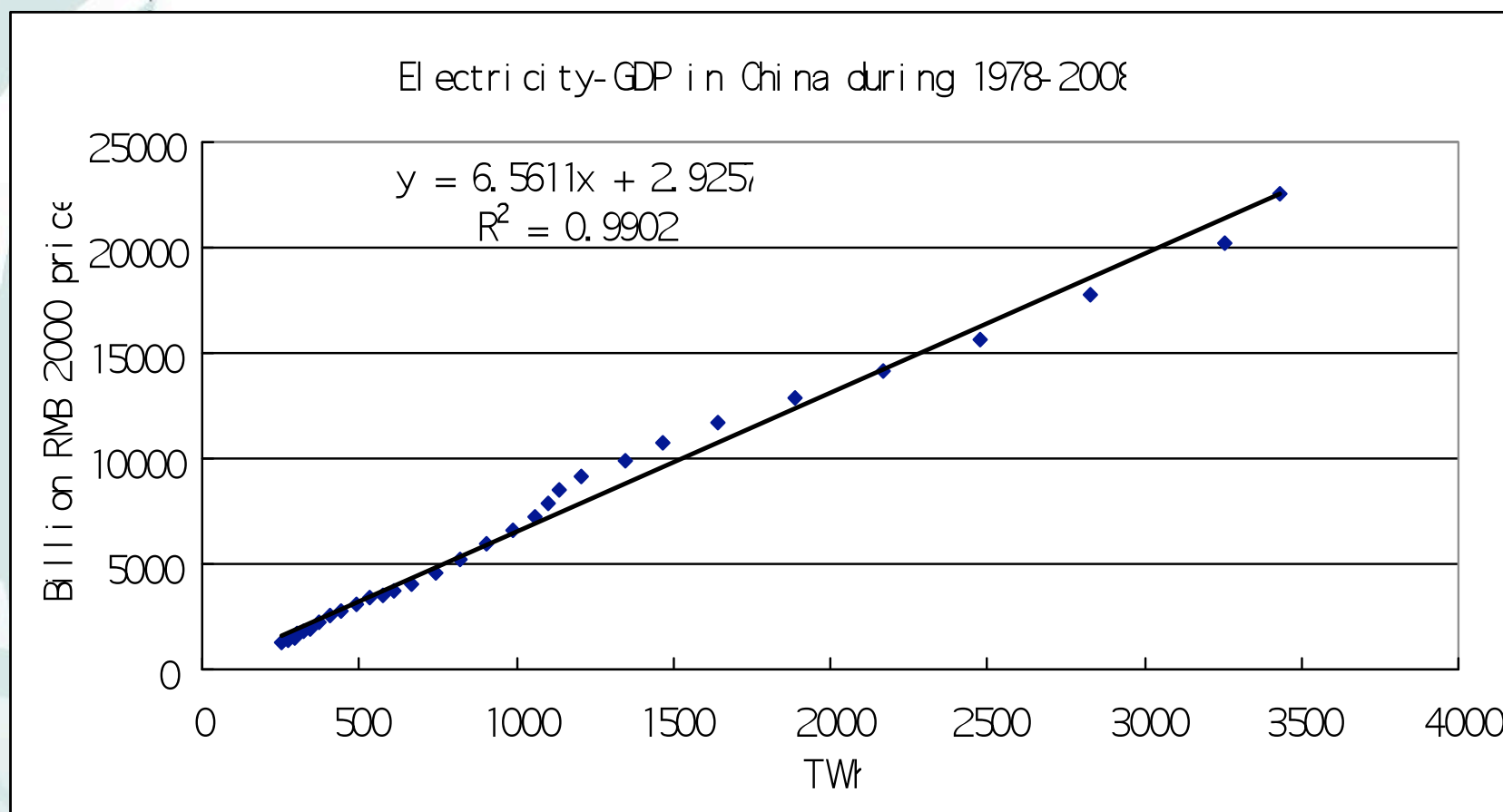
Economic model :

- Computable General Equilibrium CGE
- Input-output model (I/O table revised with RAS and EC)
- Multi-Agent Simulation Model

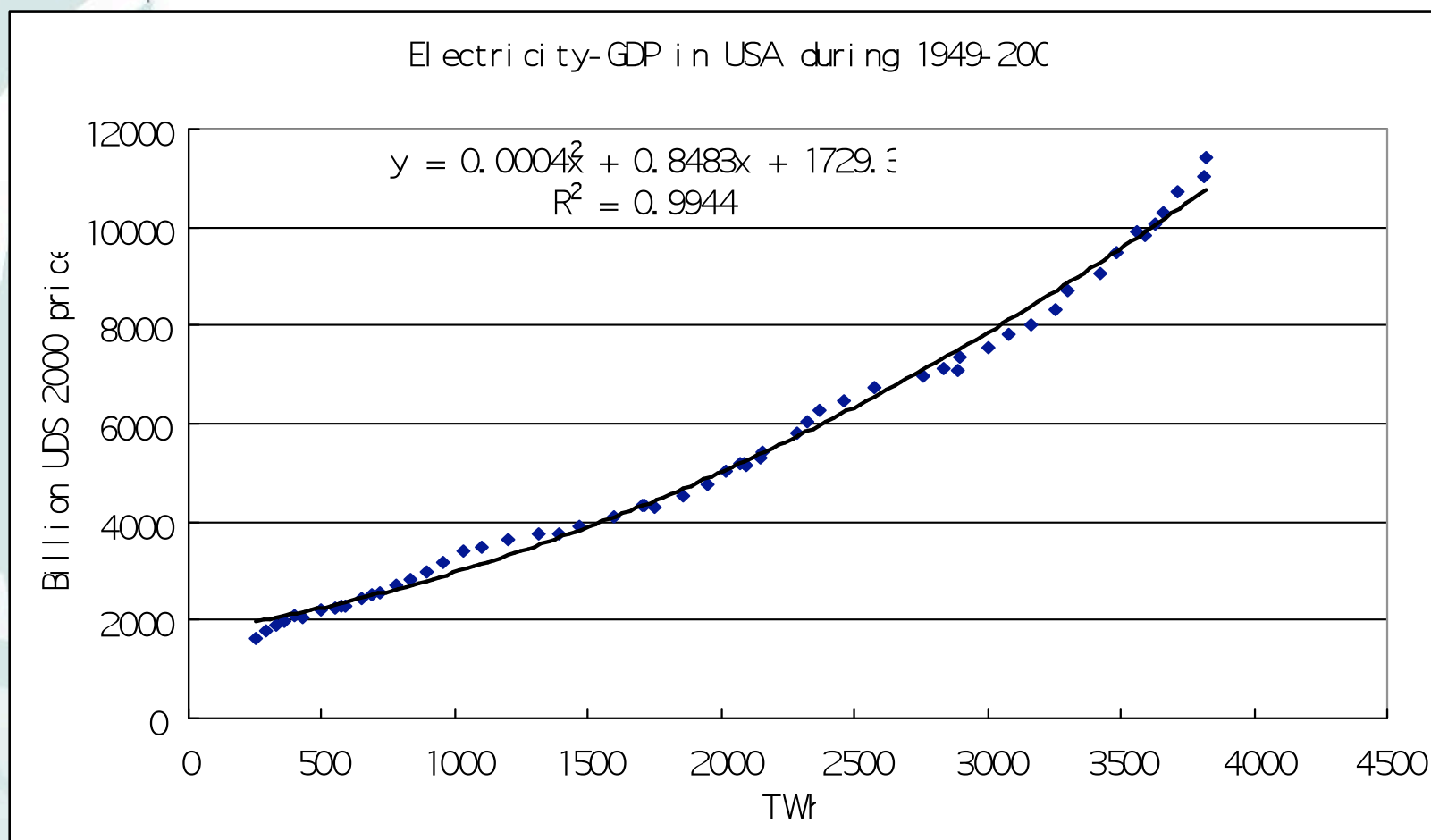
Agent Simulation of Economy



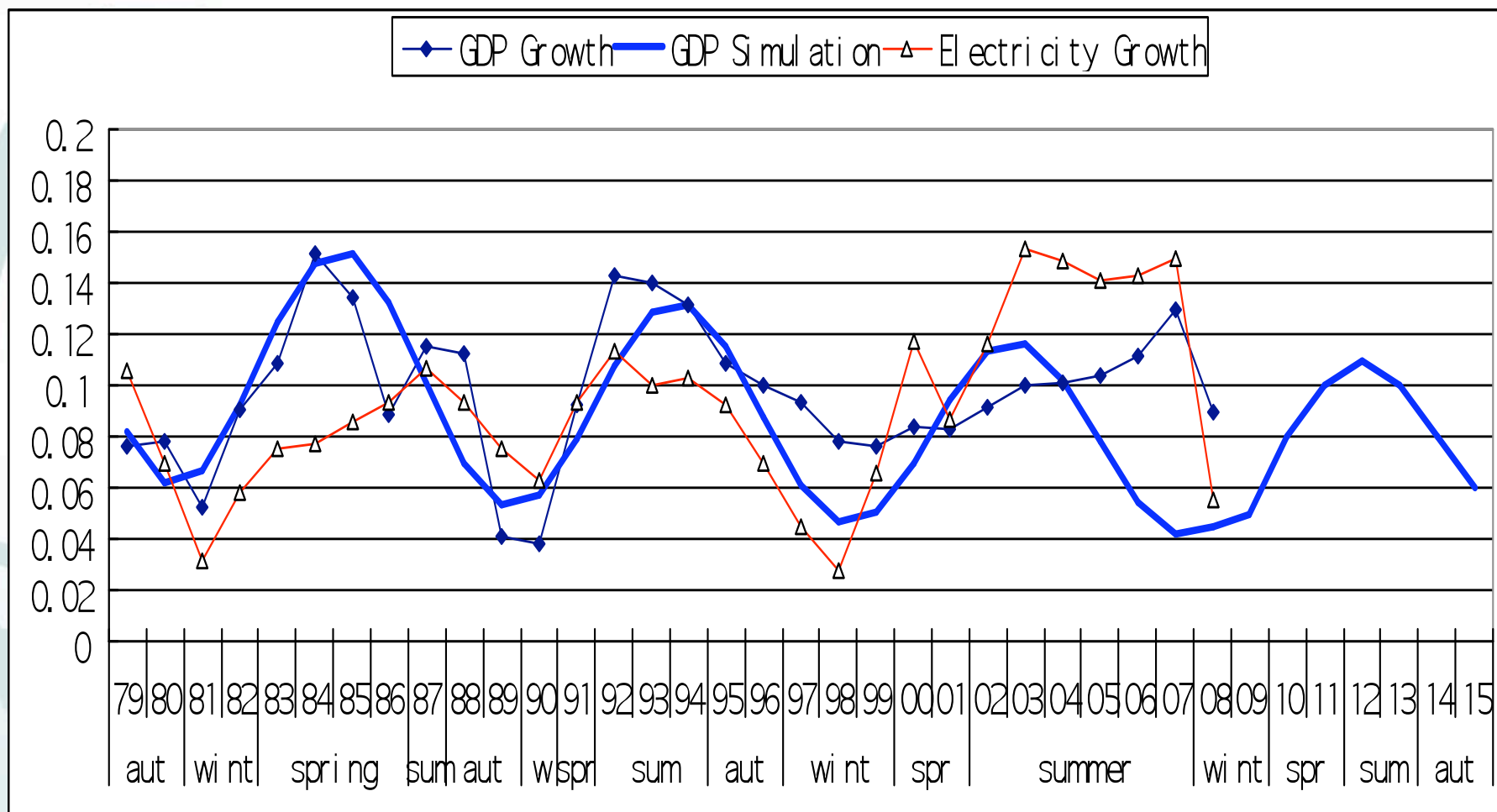
Positive Correlation on GDP-Electricity in China



Positive Correlation on GDP-Electricity in the USA



Chinese Economic Cycle: 9 Years





国家电网公司
STATE GRID
CORPORATION OF CHINA

The outlook of this slides are not statements of what will happen in China, but what might be happen in the assumptions and model used.

Thank You!

Dr.Zhaoguang HU
Vice President
State Grid Energy Research Institute
Beijing 100761
China
Tel: 86-10-6341-6619
email: huzhaoguang@sgeri.sgcc.com.cn